

# The Changing Landscape of Chemical Toxicity Values and Challenges Presented with Trichloroethylene

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# Emerging Contaminants (ECs)

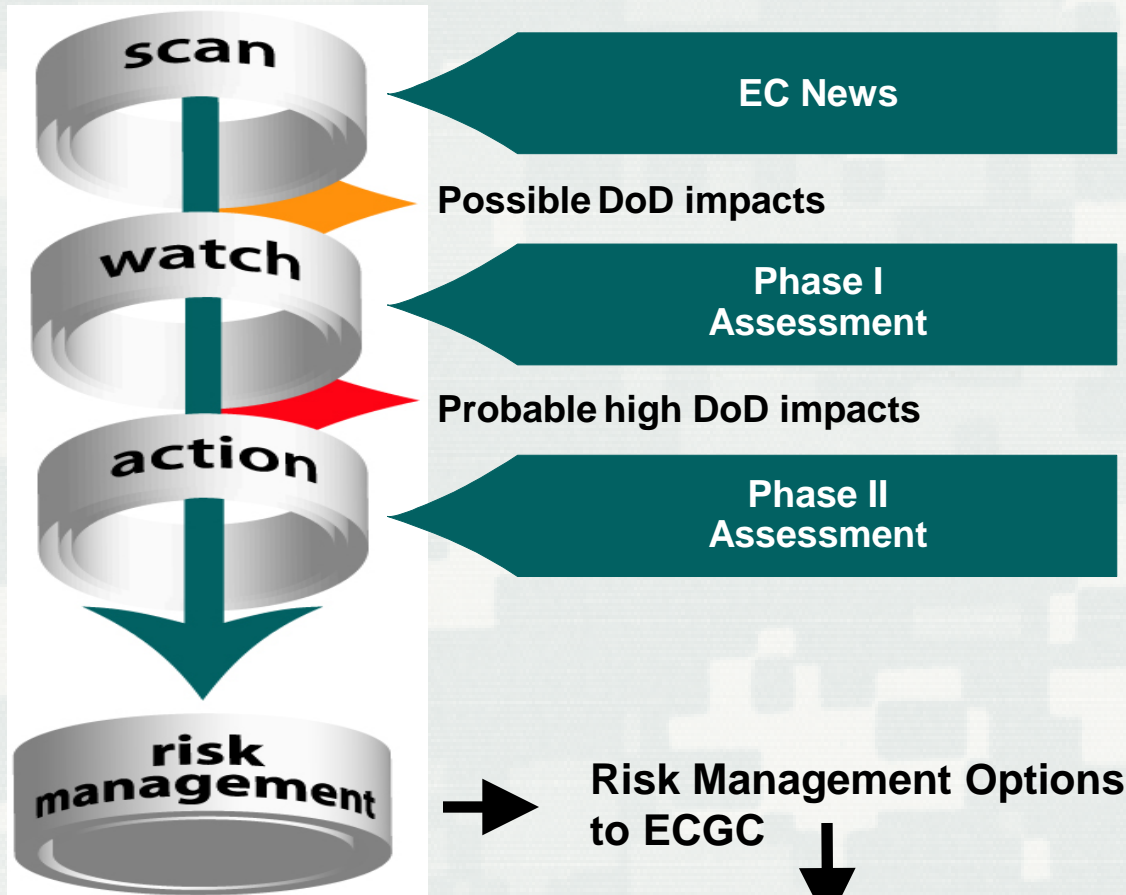
- Are chemicals or materials of interest that are characterized by:
  - ▶ a perceived or real threat to human health or environment, and
  - ▶ there is no currently published health standard or there is an existing health standard, but *the standard is evolving or being re-evaluated.*

Source: “Initiation of Emerging Contaminants Characterization and Response Actions for Protection of Human Health” Issue Paper (ECOS & DoD Sustainability Workgroup, 2008)



# DoD's Scan, Watch, Action Process: Identifying, Prioritizing & Pursuing Risk Management

Over -the- horizon



Review literature, periodicals, regulatory communications, etc.

Monitor events; Conduct Phase I qualitative impact assessment; Manage obvious risks.

Conduct Phase II quantitative impact assessment; Develop & rank risk management options (RMOs); Implement approved RMOs; Track implementation and reduce high risks; Revisit list annually for risk reduction progress and triggers for listing



Approved RMOs become Risk Management Actions (RMAs)

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# IRIS Documents Reviewed by DoD Services

- Benzo(a)pyrene
- Trimethylbenzenes
- Dioxin



# Other Chemicals of DoD Interest Undergoing IRIS Reassessment

- 1,4-Dioxane
- Dioxin (cancer)
- RDX
- Arsenic
- Phthalatates (multiple)
- Vanadium pentoxide
- Relative potency factors for PAHs
- Hexavalent chromium



# Trends Observed During Review of IRIS Documents

- Candidate RfDs and RfCs
- Biological based models reducing uncertainty factors
- Identification of developmental endpoints
- Some recommendations from NAS formaldehyde panel are being incorporated
  - ▶ Preamble describes process
  - ▶ Evidence tables
  - ▶ Manageable length



# Trichloroethylene Case Study

- IRIS Toxicological Review published September 2011
- Chronic oral RfD of 0.0005 mg/kg/day, a chronic inhalation RfC of 0.002 mg/m<sup>3</sup>; classified as "carcinogenic to humans" with an oral slope factor of  $4.6 \times 10^{-2}$  per mg/kg/day and an inhalation unit risk of  $4.1 \times 10^{-6}$  per  $\mu\text{g}/\text{m}^3$





# Inhalation Unit Risk and Oral Slope Factor

- Non-Hodgkins lymphoma
- Liver cancer
- Kidney cancer
  - ▶ Mutagenic mode of action
  - ▶ Apply age dependent adjustment factors to kidney only
- Oral values route extrapolated from inhalation unit risk



# Reference Dose and Reference Concentration

- Decreased thymus weight in mice
- Developmental immunotoxicity
- Fetal cardiac malformations

RfC:

- Decreased thymus weight in mice
- Fetal cardiac malformations
- Route extrapolated from drinking water studies



# Risk-based Screening Levels for TCE

- Under CERCLA acceptable risks are between 1E-04 and 1E-06
- 1E-06 is point of departure for remediation goals once determined an action is necessary

Risk-Based Screening Levels*		
	Res. Water (µg/L)	Air (µg/m <sup>3</sup> )
Non-Cancer Hazard of 1	2.6	2.1
10 <sup>-6</sup> Cancer Risk	0.43	0.44

Industrial/Commercial 8.8 µg/m<sup>3</sup> vs. OSHA 535 mg/m<sup>3</sup>



\* EPA Regional Screening Levels  
(residential)

# Challenges presented by IUR and OSF

- Multi step process to which yields no major difference for risk managers

0.59 vs 0.44  $\mu\text{g}/\text{m}^3$

- Low air screening level of 0.44  $\mu\text{g}/\text{m}^3$  is below common background value of 1  $\mu\text{g}/\text{m}^3$  TCE

1. Run the RSL [calculator](#) with the mutagenic option switched on to incorporate the ADAF (Age-Dependent Adjustment Factor) and estimate a TCE concentration based on kidney mutagenic endpoint (IUR of  $1\text{E-}06$  ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup> and oral slope factor of  $9.3\text{E-}03$  ( $\text{mg}/\text{kg}\cdot\text{day}$ )<sup>-1</sup>). The first page of the calculator should look like [this](#) if calculating residential soil, air and tapwater RSLs. Then, make the following changes to the [toxicity values](#) and the [properties](#) (VOC?, Mutagen? and EPD?). The [soil](#), [air](#) and [tapwater](#) results are then displayed for the mutagenic RSLs.
2. Run the RSL [calculator](#) with the mutagenic option switched off and estimate a TCE concentration based on non-kidney (NHL/liver) cancer endpoint (IUR of  $3.1\text{E-}06$  ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup> and oral slope factor of  $3.7\text{E-}02$  ( $\text{mg}/\text{kg}\cdot\text{day}$ )<sup>-1</sup>). The first page of the calculator should look like [this](#) if calculating residential soil, air and tapwater RSLs. Then, make the following changes to the [toxicity values](#) and the [properties](#) (VOC?, Mutagen? and EPD?). The [soil](#), [air](#) and [tapwater](#) results are then displayed for the mutagenic RSLs.
3. For each environmental media, take the reciprocal of the two resulting TCE RSL concentrations, and add them together ( $1/\text{conc\_mutagen} + 1/\text{conc\_cancer}$ ) before inverting back to a final RSL concentration. ( $1/(1/\text{conc\_mutagen} + 1/\text{conc\_cancer})$ ). The detailed equations for resident [soil](#), [air](#) and [tapwater](#) are presented.





# Case Study: TCE Vapor Intrusion Project

- TCE used between 1960s and 1980s
  - ▶ Underground storage tanks and piping
  - ▶ Secondary loop of coolant for ice pool inside one building
  - ▶ Underground refrigerant
- Confirmed vapor intrusion into buildings; investigation and mitigation is ongoing
- Site specific action levels exceeded – child-care and industrial values



# Case Study: TCE Vapor Intrusion Project

Various management options pursued

- HVAC system
- Sub slab depressurization
- Air purifiers
- Office relocation

Some samples of outdoor air exceed residential screening level



# Challenges Presented by Noncancer Values

- The chronic RfC is protective of long-term exposures to sensitive subpopulations
  - ▶ But what about critical exposure period?
- Vapor intrusion is highly variable
  - ▶ Seasonally influenced by heating/cooling; groundwater table
  - ▶ Daily influences, wind, doors opening/closing
- How should excursions above action level be monitored and managed?



# Management/Communication Challenges

- Who's OK and who is not?
  - ▶ Privacy concerns regarding requests for relocation
- Credibility – how long do we wait for an answer from HQEPA?
- Management of real time data and variability– when do we take action?  
Readings may be high one hour and not the next.





# Monitoring Strategies



# Remaining Questions and Issues

- Differing interpretations by EPA Regions and States
- Does a chronic RfC represent a critical exposure window of ~ 2 weeks?
- RAGS Pt F: Exposure duration evaluated should be consistent with exposure duration represented by the toxicity value
- Why not publish developmental RfC/RfDs per the EPA *Guidelines for Developmental Toxicity Risk Assessment*?

